NORTHEAST ELECTRONICS

A DIVISION OF NORTHERN TELECOM, INC.

INSTRUCTION MANUAL

# TTS 59A

# PORTABLE MF SENDER

No. A0059-10-600 ISSUE 2 DATE APRIL 1971

PRINTED IN U.S.A.

Airport Rd., Concord, N.H. 03301 • (603) 224-6511 • TELEX 94-3453

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# SECTION 1

## DESCRIPTION & SPECIFICATIONS

1.1 DESCRIPTION. The Model TTS 59A is a small portable unit which permits MF and dial pulse signaling at 6-wire patch bays, toll test boards, etc. when an MF sender is not available. E and M supervisory circuits and a 2- and 4-wire talk circuit are provided.

1.2 The unit contains 6 stable transistorized L-C type oscillators factory set at 700, 900, 1100, 1300, 1500 and 1700 Hz and a mixing amplifier. A key pad with 12 pushbuttons designated 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, DP and ST is located on the front panel. Depression of any one of these keys connects the proper combination of two of the 6 oscillators to the output of the unit.

1.3 A switch designated LEVEL switches the 600Ω output to +1 dB, -6 dB, and -22 dB.

1.4 In addition to the MF Key pad, a dial is provided to permit manual pulsing on an E, M and loop basis. Keys on the front panel permit the testman to send an on hook or off hook toward the line or drop of a circuit. Line and drop lamps are provided to monitor the supervision.

1.5 Jacks for a 52-type headset, connected to a 2- and 4-wire talk circuit, permit the testman to monitor or communicate with the called party.

1.6 The TTS 59A is operated from an external source of 48V dc. An optional accessory, designated TTS 59XPS, can be added in the lid to provide operation on 115V ac. The cover is removable and provides a storage space for power cords, etc.

1.7 A rack-mounted unit, designated the Model TTS 59AR, is also available.

1.8 SPECIFICATIONS

MF OSCILLATORS

Fixed Frequency: 700, 900, 1100, 1300, 1500 and 1700 Hz

Freq. Tolerance: ±1% 40° to 110°F

Harmonic Distortion: 1% 40°-110°F

Output Levels: +1 dB, -6 dB, -22 dB

Output Impedance: 600Ω ±5%

POWER

Central office battery -48V dc 200 mA

Optional: 115V ac if ordered with TTS 59XPS

SIZE

Model TTS 59A - 14"w x $8\frac{3}{4}$"h x 8"d

Model TTS 59AR - $8\frac{3}{4}$" x 19" (23" adapters available on request)

WEIGHT: 15 lb.

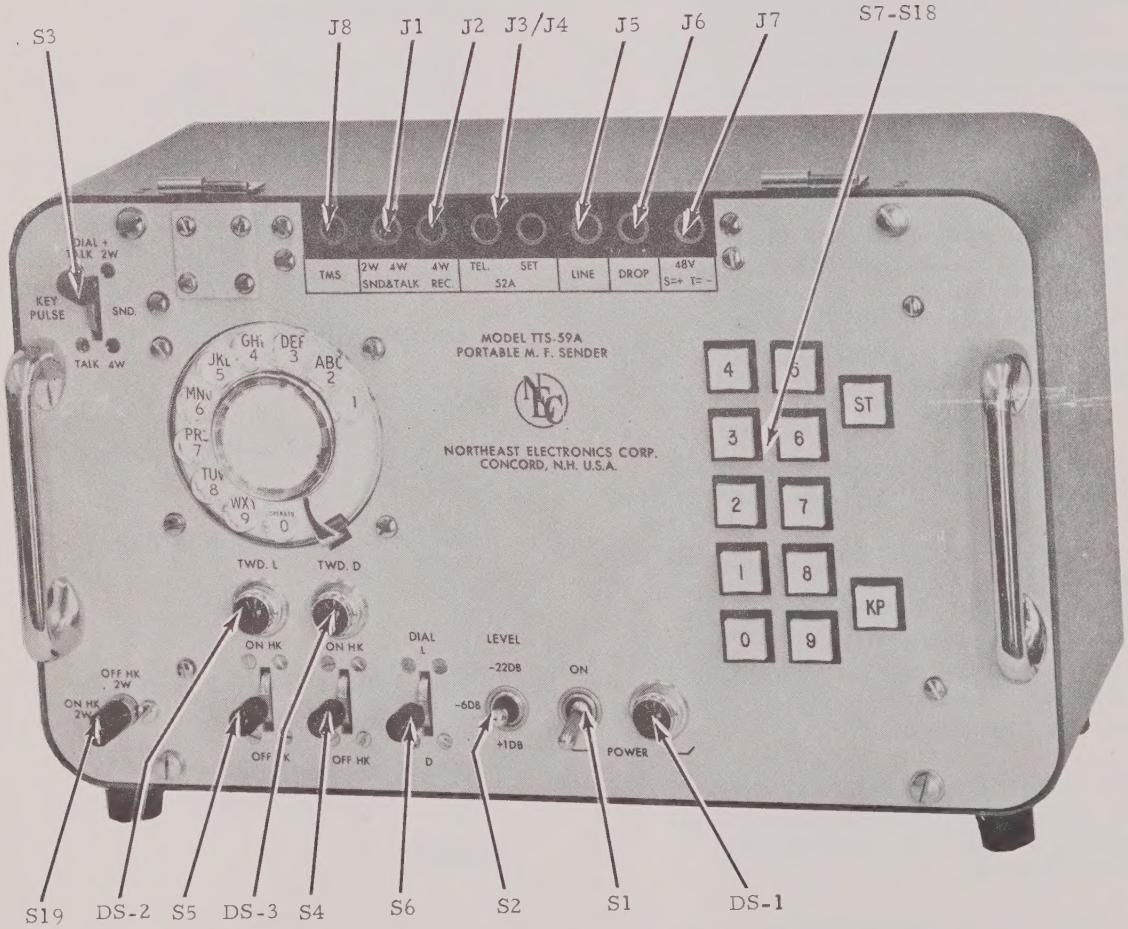



Fig. 2-1 Front Panel Controls

## SECTION 2

## OPERATING INSTRUCTIONS

2.1 FRONT PANEL CONTROLS. Fig. 2-1 and Table 2-1 locate and describe the front panel controls of the TTS 59A.

| Name of Control | Ref Desig. | Type of Control | Use or Purpose |
|---|---|---|---|
| POWER | S1 | Toggle switch | Turns power on and off to unit. |
| LEVEL | S2 | Toggle switch | a. +1 dB switches output level of MF signals to +1 dB.<br>b. -6 dB switches output level of MF signals to -6 dB.<br>c. -22 dB switches output level of MF signals to -22 dB. |
| KEY PULSE | S3 | Key switch | a. DIAL & TALK 2W conditions talk circuit for 2-wire operation.<br>b. SND connects MF oscillators to send jack.<br>c. TALK 4W conditions talk circuit for 4-wire operation. |
| TWD.D | S4 | Key switch | a. ON HK sends on hook toward the drop side.<br>b. OFF HK sends off hook toward the drop side. |
| TWD.L | S5 | Key switch | a. ON HK sends on hook toward the line side.<br>b. OFF HK sends off hook toward the line side. |
| DIAL | S6 | Key switch | a. L sends battery and ground or open pulses on M lead toward the line side under control of dial.<br>b. D sends ground and open pulses on E lead toward the drop side under control of the dial. |
| MF key pad | S7-S18 | Pushbuttons | Provide MF signaling. |
| ON HK 2W/ OFF HK 2W | S19 | Turnbutton | a. OFF HK 2W connects hold coil to 2W-4W SND+TALK jack.<br>b. ON HK 2W disconnects hold coil from 2W-4W SND+TALK jack. |



| Name of Control | Ref Desig. | Type of Control | Use or Purpose |
|---|---|---|---|
| 2W-4W SND+TALK | J1 | 310-type telephone jack. | Output for sending loop dial pulses, MF signals, 2 and 4-wire signals. |
| 4W REC | J2 | 310-type telephone jack. | Input for 4-wire talk. |
| TEL SET 52A | J3/J4 | 52A twin jack. | For 52-type headset. |
| LINE | J5 | 310-type telephone jack. | Input from E lead and output for M lead on line side. |
| DROP | J6 | 310-type telephone jack. | Input from M lead and output for E lead on drop side. |
| 48V | J7 | 310-type telephone jack. | Operating power input (sleeve positive and tip negative). |
| TMS | J8 | 310-type telephone jack. | SND+TALK jack for transmission measurements. |
| DIAL | | Standard telephone dial. | Provides dial pulsing |
| POWER lamp | DS-1 | Indicator lamp | Indicates POWER ON. |
| TWD.L | DS-2 | Indicator lamp | Provides monitor supervision on line side. |
| TWD.D | DS-3 | Indicator lamp | Provides monitor supervision on drop side. |

## 2.2 OPERATION

2.3 INITIAL STEPS. The following steps should be taken to prepare the set for operation.

a. Unlatch and open the cover. The cover can easily be detached by sliding it to the right.

b. Connect central office battery power (-48V dc tip negative and sleeve positive) using a cord equipped with a 310-type telephone plug on one end and a suitable connection on the other.

NOTE: The power cord should be connected to the TTS 59A before it is connected to the power source. When disconnecting the power cord, detach it from the power supply before detaching it from the 59A.

c. Switch the POWER switch to the ON position. The power indicator lamp will not light if the polarity is reversed.

d. Take all circuits out of service before making tests.

## 2.4 LOOP DIALING

a. Connect the circuit under test to the 2W 4W SND+TALK jack using a cord equipped with a 310-type telephone plug (tip and ring).

b. Set the KEY PULSE switch to DIAL + TALK 2W.

c. Set the OFF HK 2W/ON HK 2W turnbutton switch to OFF HK 2W.

d. Dial the desired number.

## 2.5 "M" Lead Dialing - Toward the LINE

a. Connect the LINE and DROP of the circuit under test to the LINE and DROP jacks using a dual 241 type plug.

b. Set the DIAL key switch to L.

c. Set the TWD. L key switch to OFF HK. The TWD. L indicator lamp will light to show an on hook condition on the "E" lead of the circuit.

d. Dialing will send battery and open pulses on the "M" lead of the circuit toward the line. An optional strap may be added to send battery and ground pulses if desired.

e. Setting the TWD. L key switch to ON HK will send an on hook signal on the M lead toward the line.

f. When ground is returned on the "E" lead, the TWD. L lamps will extinguish.

## 2.6 "E" Lead Dialing - Toward Drop

a. Connect the LINE and DROP of the circuit under test to the LINE and DROP jacks using a dual 241-type plug.

b. Set the DIAL key switch to D.

c. Set the TWD. D key switch to OFF HK. The TWD. D indicator lamp will light to show an on hook condition on the "E" lead of the circuit.

d. Dialing will send ground and open pulses on the "E" lead of the circuit under test toward the drop.

e. Setting the TWD. D key switch to ON HK will send an on hook signal on the "E" lead of the drop.

## 2.7 MF OPERATION

a. Set the OFF HK 2W/ON HK 2W turnbutton switch to OFF HK 2W.

b. Connect the circuit to be tested to the 2W 4W SND + TALK jack using a 310-type plug (tip and ring).

c. Set the KEY PULSE switch to SND.

d. If "E" and "M" supervision is desired, connect the "E" and "M" leads to the LINE and DROP jacks using a dual 241-type plug.

e. Set the LEVEL toggle switch to the desired output level (+1 dB, -6 dB or -22 dB).

f. Depressing the pushbuttons will send MF pulsing on the circuit under test.

g. Setting the OFF HK 2W/ON HK 2W turnbutton switch to ON HK 2W will present an on hook condition to the circuit under test.

2.8 TALKING - 2 WIRE

a. Set the OFF HK 2W/ON HK 2W turnbutton switch to OFF HK 2W.

b. Connect the 2-wire circuit to the 2W/4W SND+TALK jack using a 310-type plug. (tip and ring).

c. Connect a 52-type headset or equivalent to the TEL SET 52A jacks.

d. Set the KEY PULSE switch to DIAL & TALK 2W.

e. The set is now prepared for talking on a 2-wire basis. The talk circuit is powered internally to allow operationo on either a "wet" or "dry" circuit.

2.9 TALKING - 4 WIRE

a. Set the OFF HK 2W/ON HK 2W turnbutton switch to OFF HK 2W.

b. Connect the transmit pair of the 4-wire circuit to the 2W 4W SND+TALK jack using a 310-type plug (tip and ring).

c. Connect the receive pair of the 4-wire circuit to the 4W REC jack using a 310-type plug (tip and ring).

d. Connect a 52-type headset or equivalent to the TEL SET 52A jack.

e. Set the KEY PULSE switch to TALK 4W.

f. The set is now prepared for talking on a 4-wire basis.

2.10 TRANSMISSION MEASUREMENTS -2W

a. Set the OFF HK 2W/ON HK 2W turnbutton switch to OFF HK 2W.

b. Connect the 2-wire circuit to the 2W 4W SND+TALK jack using a 310-type plug (tip and ring).

c. Set the KEY PULSE switch to DIAL + TALK 2W.

d. Connect a transmission measuring set to the TMS jack using a 310-type plug (tip and ring). Transmission measurements can now be made on the circuit under test.

2.11 TRANSMISSION MEASUREMENTS -4W

a. Set the OFF HK 2W/ON HK 2W turnbutton switch to OFF HK 2W.

b. Connect the transmit pair of the 4-wire circuit to the 2W 4W SND+TALK jack using a 310-type plug (tip and ring).

c. Connect the receive pair of the 4-wire circuit to the 4W REC jack using a 310-type plug (tip and ring).

d. Set the KEY PULSE switch to TALK 4W.

e. Connect a transmission measuring set to the TMS jack using a 310-type plug (tip and ring). Transmission measurements may now be made on the transmit pair of the 4-wire circuit.

# SECTION 3

## CIRCUIT DESCRIPTION

3.1 GENERAL. The circuit description of the TTS 59A is presented in two parts, the set in general and the MF adapter card, E95148.

3.2 CIRCUIT DESCRIPTION.

3.3 Power is applied to the set through the 48V jack (T=- S=+), the POWER switch and the power reversal protection diode CR1. Resistor R2 and zener diodes CR2 and CR3 act as a voltage divider and regulator circuit for the MF adapter card voltage.

3.4 Toggle switch S2 works in conjunction with resistors R3, R711, R712 and R713 to adjust the MF output level.

3.5 Table 3-2 shows the output frequency combinations transmitted by the MF adapter card by means of switches S7 through S18.

TABLE 3-2 MF GENERATOR

| Pushbutton | Frequency |
|---|---|
| 1 (S-8) | 700 + 900 |
| 2 (S-9) | 700 + 1100 |
| 3 (S-10) | 900 + 1100 |
| 4 (S-11) | 700 + 1300 |
| 5 (S-12) | 900 + 1300 |
| 6 (S-13) | 1100 + 1300 |
| 7 (S-14) | 700 + 1500 |
| 8 (S-15) | 900 + 1500 |
| 9 (S-16) | 1100 + 1500 |
| 0 (S-7) | 1300 + 1500 |
| KP (S-18) | 1100 + 1700 |
| ST (S-17) | 1500 + 1700 |

3.6 Setting the KEY PULSE switch, S3, to the SND position switches the output of the MF adapter to the 2W 4W SND & TALK jack. The output circuit is DC blocked and has an output impedance of 600Ω, but can be changed by the selection of the proper value of resistor R1 on the MF adapter card.

3.7 Setting the KEY PULSE switch, S3, in the DIAL & TALK 2W position connects the talk, send and receive circuits to the 4W SND & TALK jack. Resistor R1 provides voltage dropping for the talk coil while capacitor C1 serves to reduce the impedance from the voltage source. Loop dialing can be accomplished in either the SND or DIAL & TALK 2W positions.

3.8 Setting the KEY PULSE switch, S3, in the TALK 4W position places the talk circuit to 4-wire operation. The transmit pair of the circuit is connected to the 2W 4W SND & TALK jack with capacitor C2 providing DC blocking and the receive pair connected the 4W REC jack.

3.9 The operation of the supervision and dialing circuits can easily be followed with reference to the schematic diagram, Fig. 3-1. The TWD. L and TWD. D indicator lamps, DS2 and DS3 respectively, when illuminated, indicate an on hook condition of the circuits under test.

3.10 The MF Adapter Card E95148

3.11 GENERAL. The MF adapter is a printed circuit plug-in sub-unit designed to generate multi-frequency tones used in telephone transmission and other systems requiring tone signaling. This card contains six individual L-C tuned oscillators, each of which is coupled to a common output amplifier circuit through the individually controlled switching circuits. The control leads from the six switching circuits (gate circuits) are brought to connector terminals to allow external programming of the six frequencies. Logic is included on the card to provide standard MF signaling.

3.12 Power is supplied to the board through pins A and U (filtered 24V dc and 12V dc respectively).

3.13 DETAILED CIRCUIT DESCRIPTION

3.14 The six oscillators and associated switching circuits are identical except for selected values in the tuned circuits. Course tuning of each oscillator is accomplished by the proper selection of tuning capacitors and fine tuning by adjusting the variable inductor of each circuit.

3.15 The output of the oscillator circuits are coupled to the common input of the output amplifier stage through their associated switching circuits. The switching circuit resembles a pi type attenuator in which the series element is a field-effect transistor. The purpose of the field-effect is to increase or decrease the amount of attenuation under control of its associated control gate, thus producing a switching action to gate the individual frequencies on and off or as programmed.

3.16 The potentiometers, R106, R206, etc. which are part of the series circuit coupling the output of the oscillators to their associated field-effect transistors are provided to adjust the output level of the oscillators on an individual basis. Input level control for the amplifier circuit is provided by potentiometer R12.

3.17 The output amplifier consists of a conventional common emitter, 2-stage amplifier. This amplifier drives an emitter follower stage, the output of which is coupled to the output transformer, T1. Capacitor C1 in the secondary of T1, provides DC blocking and resistor R1 provides the resistance buildout for the desired output impedance, normally 600Ω.

3.18 Diodes CR1 through CR24 provide the keying logic for standard MF signaling. These control points are brought out to pins to allow external programming of the keying logic.

# SECTION 4

## MAINTENANCE & CALIBRATION

4.1 MAINTENANCE. Little or no maintenance should ever be required for this portable MF sender.

4.2 CALIBRATION. This unit has been carefully calibrated and tested before shipment and should not need recalibration except in cases of age or misuse. If recalibration is required, the following steps should be taken using the recommended equipment shown in Table 4-1.

4.3 Connect a 48V power supply to the 48V jack using a 310-type telephone plug (tip negative, sleeve positive).

4.4 Set the front panel controls of the 59A as follows:

| CONTROL | SETTING |
|---|---|
| POWER | ON |
| LEVEL | +1 dB |
| DIAL | Normal |
| TWD. D | Normal |
| TWD. L | Normal |
| ON HK 2W/OFF HK 2W | ON HK 2W |
| KEY PULSE | SND |

Use the above settings except where otherwise noted.

4.5 PROCEDURE

a. Connect an AC Voltmeter to the 2W 4W SND+TALK jack using a 310-type plug (tip and ring).

b. Connect a counter to the AC voltmeter and an oscilloscope to the counter.

c. Connect ground to pin 6 of pc board E95148.

d. Adjust potentiometer R12 on pc board E95148 for a maximum output level.

e. Adjust pot R606 on pc board E95148 for an output level of +5 dB.

f. Adjust variable inductor, L601, for an output frequency of 700 Hz ±1%.

g. Disconnect the ground from pin 6 and connect to pin 7 on same board.

h. Adjust pot R406 on above pc board for an output level of +5 dB.

i. Adjust variable inductor L401 for an output frequency of 900 Hz ±1%.

j. Disconnect the ground from pin 7 and connect to pin 8 on same bd.

TABLE 4-1

| DESCRIPTION | MANUFACTURER & MODEL |
|---|---|
| 1. AC Voltmeter | HP 400FL or equivalent. |
| 2. Oscilloscope | Tektronic Type 504 or equivalent. |
| 3. Counter | NEC TTS 80C or equivalent. |
| 4. Power supply | Central office battery or equivalent. |

k. Adjust pot R206 on pc bd E95148 for an output level of +5 dB.

l. Adjust variable inductor, L201, for an output frequency of 1100 Hz ±1%.

m. Disconnect the ground from pin 8 and connect to pin 9.

n. Adjust pot R506 on same board for an output level of +5 dB.

o. Adjust variable inductor, L501, for an output frequency of 1300 Hz ±1%.

p. Disconnect the ground from pin 9 and connect to pin 10.

q. Adjust pot R306 for an output level of +5 dB.

r. Adjust variable inductor, L301, for an output frequency of 1500 Hz ±1%.

s. Disconnect the ground from pin 10 and connect to pin 11.

t. Adjust pot R106 for an output level of +5 dB.

u. Adjust variable inductor L101 for an output frequency of 1700 Hz ±1%.

v. Disconnect the ground from pin 11.

w. Depress the "0" pushbutton on the MF key pad and adjust pot R12 for an output of +1 dB.

x. Depress each pushbutton on the MF key pad and make sure that the output level is +1 dB ±0.5 dB. If not, refer to Table 4.2 and adjust the potentiometer of the two oscillators involved to produce the necessary output level.

# SECTION 5

## SCHEMATIC DIAGRAM

5.1 INTRODUCTION. The following pages contain the schematic diagrams for the Model TTS 59A.

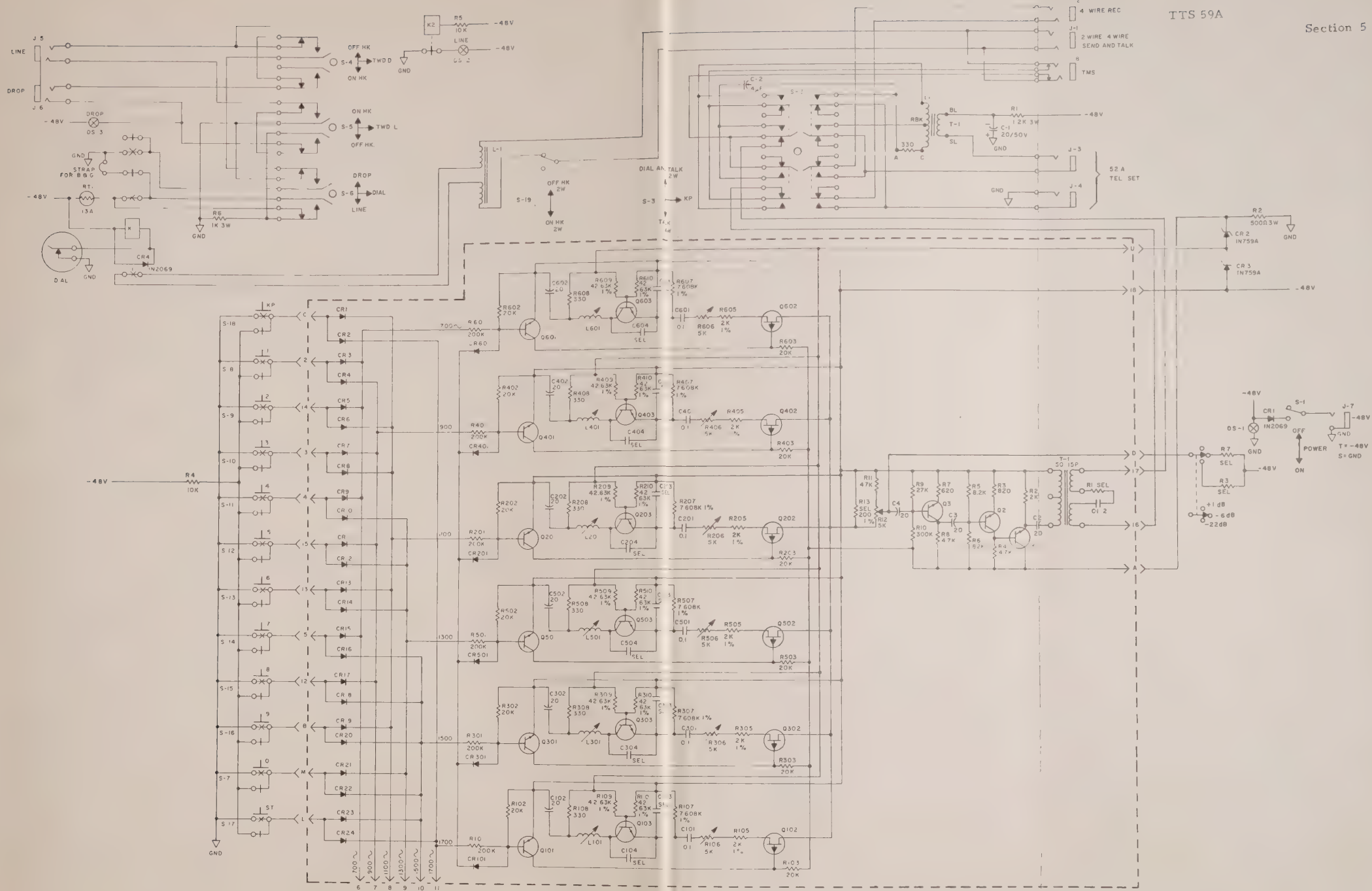


Fig. 5-1 Schematic Diagram TTS 59A

# SECTION 6

## ELECTRONIC PARTS LIST

6.1 INTRODUCTION. The following pages contain the parts list for the Model TTS 59A.

6.2 FSCM Code Numbers. The Federal Supply Code of Manufacturers of each part. A list of manufacturers and their respective code numbers is listed below.

| Code | Manufacturer |
|---|---|
| 01121 | Allen Bradley |
| 01295 | Texas Instruments |
| 04221 | Aemco |
| 06819 | NEC |
| 07716 | IRC |
| 13606 | Sprague |
| 15873 | Motorola |
| 24446 | General Electric |
| 40009 | Arrow-Hart & Hegeman |
| 49671 | RCA |
| 71590 | Centralab |
| 72619 | Dialco |
| 72663 | General Control |
| 78277 | Potter & Brumfield |
| 80223 | UTC |
| 80368 | Sylvania |
| 82389 | Switchcraft |
| 86151 | Ceeco |
| 90201 | Mallory |
| Alco* | No FSCM number listed |

## Front Panel

| Ref Desig. | Description | Manufacturer (FSCM Code #) | Part Number |
|---|---|---|---|
| C1 | C: 20μF 50V | 13606 | TE1305 |
| C2 | C: 4μF 150V | 13606 | 121P4059R15S4 |
| CR1 | Diode | 80368 | 1N2069 |
| CR2 and CR3 | Diodes: zener | 15873 | 1N759A |
| CR4 | Diode | 80368 | 1N2069 |
| XDS1 | Lamp assembly | 72619 | 81-0410-0111-301 |
| XDS1-2 | Lamp assembly | 72619 | 81-0410-0112-301 |
| XDS1-3 | Lamp assembly 55V | 24446 | 1835 |
| J1,J2,J5,J6 | Jacks: T-R-S | 82389 | 5J1329 |
| J3,J4,J7 | Jacks: T-S | 82389 | 5J1194 |
| J8 | Jack | 82389 | 5J1192 |
| K1 | Relay: 4C 48V | 04221 | 156-14D100 |
| K2 | Relay: 1C | 78277 | 4R-1200OLG-SIL |
| L1 | Hold coil | 06819 | TN1274 |
| R1 | R: 1.2K ±5% 3W | 13606 | 242E1225 |
| R2 | R: 500Ω ±5% 3W | 13606 | 242E5015 |
| R3 and R7 | R: sel val | | |
| R4 and R5 | R: fxd 10K ±10% ½W | 01121 | RC20 |
| R6 | R: 1K ±5% 3W | 13606 | 242E1025 |
| RT1 | Resistance Lamp | 80368 | GB13A |
| S1 | S: toggle | 40009 | 81015-BP |
| S2 | S: toggle | Alco* | MSTG-206PA |
| S3 | S: key | 82389 | 173P |
| S4 thru S6 | S: key | 72663 | MCT4-T1-D-D-D-D |
| S7 | S: box type | 82389 | 24S-1001 |
| S8 | S: box type | 82389 | 24S-1002 |
| S9 | S: box type | 82389 | 24S-1003 |
| S10 | S: box type | 82389 | 24S-1004 |
| S11 | S: box type | 82389 | 24S-1005 |
| S12 | S: box type | 82389 | 24S-1006 |
| S13 | S: box type | 82389 | 24S-1007 |
| S14 | S: box type | 82389 | 24S-1008 |
| S15 | S: box type | 82389 | 24S-1009 |
| S16 | S: box type | 82389 | 24S-1010 |
| S17 | S: box type | 82389 | 24S-1012 |
| S18 | S: box type | 82389 | 24S-1011 |
| S19 | S: turnbutton | 82389 | 9S-1097 |
| T1 | Talk coil | 86151 | CE-104A |

PC Board E95148

| Ref Desig. | Description | Manufacturer (FSCM Code #) | Part Number |
|---|---|---|---|
| R1 and R13 | R: sel val | | |
| R2 | R: 2K ±10% ½W | 01121 | RC20 |
| R3 | R: 820Ω ±10% ½W | 01121 | RC20 |
| R4 | R: 4.7K ±10% ½W | 01121 | RC20 |
| R5 | R: 8.2K ±10% ½W | 01121 | RC20 |
| R6 | R: 82K ±10% ½W | 01121 | RC20 |
| R7 | R: 620Ω ±10% ½W | 01121 | RC20 |
| R8, R11 | R: 4.7K ±10% ½W | 01121 | RC20 |
| R9 | R: 27K ±10% ½W | 01121 | RC20 |
| R10 | R: 300K ±10% ½W | 01121 | RC20 |
| R12 | R: 5K pot | 90201 | MTC-1 |
| C1 | C: 2μF 150V | 13606 | 121PZ |
| C2 thru C4 | C: 20μF 50V | 13606 | TE-1305 |
| CR1 thru CR24 | Diodes | 80368 | 1N198 |
| Q1 thru Q3 | Transistors | 49671 | 2N2102 |
| T1 | Transformer | 80223 | S0-15P |
| R101, R201, R301, R401 R501, R601 | Resistors: 200K ±10% ½W | 01121 | RC20 |
| R102, R202, R302, R402, R502, R602 | Resistors: 20K ± 10% ½W | 01121 | RC20 |
| R103, R203, R303, R403, R503, R603 | Resistors: 20K ±10% ½W | 01121 | RC20 |
| R104, R204, R304, R404, R504, R604 | Not used | | |
| R105, R205, R305, R405, R505, R605 | Resistors: 2.0K | 07716 | CEATO |
| R106, R206, R306, R406, R506, R606 | Resistors: 5K pot | 90201 | MTC-1 |
| R107, R207, R307, R407, R507, R607 | Resistors: 7.608K ±1% ¼W | 07716 | CEATO |
| R108, R208, R308, R408, R508, R608 | Resistors: 330Ω ±10% ½W | 01121 | RC20 |
| R109, R209, R309, R409, R509, R609 | Resistors: 42.63K ±1% 1/8W | 07716 | CEATO |
| R110, R210, R310, R410, R510, R610 | Resistors: 42.63K ±1% ¼W | 07716 | CEATO |
| C101, C201 C301, C401, C501, C601 | Capacitors: 0.1μF 75V | 71590 | DDA-104 |

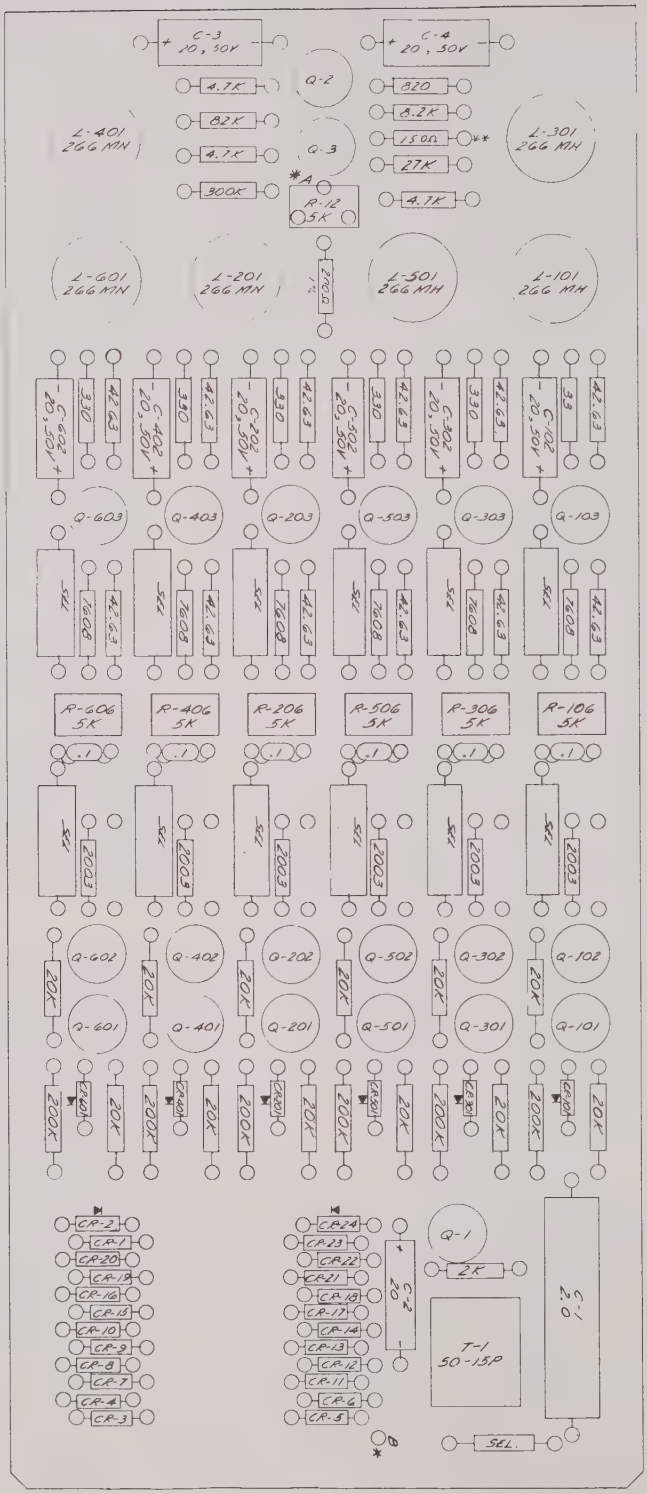



Fig. 6-1 Component Location E95148

| Ref Desig. | Description | Manufacturers (FSCM Code #) | Part Number |
|---|---|---|---|
| C102, C202, C302, C402, C502, C602 | Capacitors: 20μF 50V | 13606 | TE 1305 |
| C103, C203, C303, C403, C503, C306 | Capacitors: sel val | | |
| C104, C204, C304, C404, C504, C604 | Capacitors: sel val | | |
| CR101, CR201, CR301, CR401, CR501, CR601 | Diodes | 80368 | 1N198 |
| Q101, Q201, Q301, Q401, Q501, Q601 | Transistors | 49671 | 2N2102 |
| Q102, Q202, Q302, Q402, Q502, Q602 | Transistors, FET | 01295 | 2N3820 |
| Q103, Q203, Q303, Q403, Q503, Q603 | Transistors | 49671 | 2N2102 |

## APPENDIX A

### 9—75

1. Replace all parts lists and assembly drawings in Section 6 with the attached

2. Replace the overall schematic diagram in Section 5 with the attached.

**Table 6—1. TTS 59A Overall Parts List.**

| REFERENCE DESIGNATOR | DESCRIPTION VALUE | POWER | TOL | VOLTS | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|---|---|---|
| CB1 | CB1 | | | | | | B005910005 |
| CR1 | D041 3 400V | | | | HORIZON | 1N4004 | 560040040 |
| DS1,2,3 | MINI BAYONET | | | | GE | 1835 | 730002000 |
| J1,2,5,6 | SPECIAL | | | | SWCRFT | 5J-1329 | 650401300 |
| J3,4,7 | SPECIAL | | | | SWCRFT | 5J-1194 | 650401200 |
| J8 | SPECIAL | | | | SWCRFT | 5J-1192 | 650401000 |
| J9 | 18 PIN DUAL EYELET | | | | AMPHNOL | 225-21821-100 | 651700900 |
| K1 | 2.6K 48V | | | | MIDTEX | 156-14D100 | 604100100 |
| K2 | 12K 1.2MA | | | | SIGMA | 4R-12000LG-SIL | 604500100 |
| L1 | 4H | | | | NEWTON | TN1274 | 450200200 |
| PC1 | E-95648 PC BD | | | | | | D005911006 |
| R3 | 13.7 1/8W 1% | | | | ELECTRA | MF5C | 220213791 |
| R4 | 10K 1/2W 10% | | | | AB | TYPE EB | 200201036 |
| R7 | 150 1/8W 1% | | | | ELECTRA | MF5C | 220215001 |
| RT1 | LAMP,RES,B1-PIN | | | | SYL | GE-13A | 730100100 |
| S1 | SPST 6A 125V | | | | J B-T | ST12A | 620100100 |
| S2 | DP3T 6A 125V | | | | ALCO | MSTG-206PA | 620500200 |
| S3 | 4C-4C CONTACT | | | | SCARLSON | 173P | 630100700 |
| S4,5,6 | SW, KET, ID-ID-ID | | | | SCARLSON | 294002-724 | 630101300 |
| S7 | SPDT LABEL 0 WHITE | | | | SWCRFT | 24S-1001 | 635100100 |
| S8 | SPDT LABEL 1 WHITE | | | | SWCRFT | 24S-1002 | 635100200 |
| S9 | SPDT LABEL 2 WHITE | | | | SWCRFT | 24S-1003 | 635100300 |
| S10 | SPDT LABEL 4 WHITE | | | | SWCRFT | 24S-1004 | 635100400 |
| S11 | SPDT LABEL 4 WHITE | | | | | 24S-1005 | 635100500 |
| S12 | SPDT LABEL 5 WHITE | | | | SWCRFT | 24S-1006 | 635100600 |
| S13 | SPDT LABEL 6 WHITE | | | | SWCRFT | 24S-1007 | 635100700 |
| S14 | SPDT LABEL 7 WHITE | | | | SWCRFT | 24S-1008 | 635100800 |
| S15 | SPDT LABEL 8 WHITE | | | | SWCRFT | 24S-1009 | 635100900 |
| S16 | SPDT LABEL 9 WHITE | | | | SWCRFT | 24S-1010 | 635101000 |
| S17 | SPDT LABEL ST WHITE | | | | SWCRFT | 24S-1012 | 635101200 |
| S18 | SPDT LABEL KP WHITE | | | | SWCRFT | 24S-1011 | 635101100 |
| S19 | 2C LOCKING | | | | SWCRFT | 9S-1097 | 640100200 |
| S20 | DIAL, TEL. | | | | AE | D-84821-C | 836000100 |
| T1 | TALK COIL | | | | CECO | CE-104A | 450100100 |

## Table 6—2. Oscillator Circuit Board E95648 Parts List.

| REFERENCE DESIGNATOR | DESCRIPTION VALUE | POWER | TOL | VOLTS | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|---|---|---|
| C1 | 2UF | | | 200V | E-DYNE | D-2.0-200-10 | 301302C50 |
| C2 | 6.8UF | | 10% | 20V | KEMET | T330A685K020AS | 310006850 |
| C3 | 6.8UF | | 10% | 20V | KEMET | T330A685K020AS | 310006850 |
| C4 | 6.8UF | | 10% | 20V | KEMET | T330A685K020AS | 310006850 |
| C101 | .1UF | Y5V | TC 20% | 50V | ERIE | 8121-050-651-104M | 330801040 |
| C102 | 6.8UF | | 10% | 20V | KEMET | T330A685K020AS | 310006850 |
| C103 | .04UF | | 10% | 100V | SPRAGUE | 225P40391WD3 | 320004030 |
| C104 | .04UF | | 10% | 100V | SPRAGUE | 225P40391WD3 | 320004030 |
| C201 | .1UF | Y5V | TC 20% | 50V | ERIE | 8121-050-651-104M | 330801040 |
| C202 | 6.8UF | | 10% | 20V | KEMET | T330A685K020AS | 310006850 |
| C203 | 091UF | | 10% | 100V | SPRAGUE | 225P91391WD3 | 320009130 |
| C204 | 091UF | | 10% | 100V | SPRAGUE | 225P91391WD3 | 320009130 |
| C301 | .1UF | Y5V | TC 20% | 50V | ERIE | 8121-050-651-104M | 330801040 |
| C302 | 6.8UF | | 10% | 20V | KEMET | T330A685K020AS | 310006850 |
| C303 | .056UF | | 10% | 100V | SPRAGUE | 225P56391WD3 | 320005630 |
| C304 | .056UF | | 10% | 100V | SPRAGUE | 225P56391WD3 | 320005630 |
| C401 | .1UF | Y5V | TC 20% | 50V | ERIE | 8121-050-651-104M | 330801040 |
| C402 | 6.8UF | | 10% | 20V | KEMET | T330A685K020AS | 310006850 |
| C403 | .15UF | | 10% | 100V | SPRAGUE | 225P15491XD3 | 320001540 |
| C404 | .12UF | | 10% | 100V | SPRAGUE | 225P12491XD3 | 320001240 |
| C501 | .1UF | Y5V | TC 20% | 50V | ERIE | 8121-050-651-104M | 330801040 |
| C502 | 6.8UF | | 10% | 20V | KEMET | T330A685K020AS | 310006850 |
| C503 | .068UF | | 10% | 100V | SPRAGUE | 225P68391WD3 | 320006830 |
| C504 | .068UF | | 10% | 100V | SPRAGUE | 225P68391WD3 | 320006830 |
| C601 | .1UF | Y5V | TC 20% | 50V | ERIE | 8121-050-651-104M | 330801040 |
| C602 | 6.8UF | | 10% | 20V | KEMET | T330A685K020AS | 310006850 |
| C603 | .22UF | | 10% | 100V | SPRAGUE | 225P22491XD3 | 320002240 |
| C604 | .22UF | | 10% | 100V | SPRAGUE | 225P22491XD3 | 320002240 |
| CR1-24 | DO35 | 500MW | | 75V | TRNSTRCN | 1N4148 | 560041480 |
| CR101 | DO35 | 500MW | | 75V | TRNSTRCN | 1N4148 | 560041480 |
| CR201 | DO35 | 500MW | | 75V | TRNSTRCN | 1N4148 | 560041480 |
| CR301 | DO35 | 500MW | | 75V | TRNSTRCN | 1N4148 | 560041480 |
| CR401 | DO35 | 500MW | | 75V | TRNSTRCN | 1N4148 | 560041480 |
| CR501 | DO35 | 500MW | | 75V | TRNSTRCN | 1N4148 | 560041480 |
| CR601 | DO35 | 500MW | | 75V | TRNSTRCN | 1N4148 | 560041480 |
| L101 | INDUCTOR,VAR, 475-525MH | | | | SANGAMO | NV-245-36370 | 455100100 |
| L201 | INDUCTOR,VAR, 475-525MH | | | | SANGAMO | NV-245-36370 | 455100100 |
| L301 | INDUCTOR,VAR, 475-525MH | | | | SANGAMO | NV-245-36370 | 455100100 |
| L401 | INDUCTOR,VAR, 475-525MH | | | | SANGAMO | NV-245-36370 | 455100100 |
| L501 | INDUCTOR,VAR, 475-525MH | | | | SANGAMO | NV-245-36370 | 455100100 |
| L601 | INDUCTOR,VAR, 475-525MH | | | | SANGAMO | NV-245-36370 | 455100100 |
| Q1 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |
| Q2 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |
| Q3 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |
| Q101 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |
| Q102 | TO92 | -15MA | | 25V | TI | 2N3820 | 555038200 |
| Q103 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |
| Q201 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |
| Q202 | TO92 | -15MA | | 25V | TI | 2N3820 | 555038200 |
| Q203 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |
| Q301 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |
| Q302 | TO92 | -15MA | | 25V | TI | 2N3820 | 555038200 |
| Q303 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |

**Table 6—2. (cont'd).**

| REFERENCE DESIGNATOR | DESCRIPTION VALUE | POWER | TOL | VOLTS | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|---|---|---|
| Q401 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |
| Q402 | TO92 | -15MA | | 25V | TI | 2N3820 | 555038200 |
| Q403 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |
| Q501 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |
| Q502 | TO92 | -15MA | | 25V | TI | 2N3820 | 555038200 |
| Q503 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |
| Q601 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |
| Q602 | TO92 | -15MA | | 25V | TI | 2N3820 | 555038200 |
| Q603 | TO92AFA | 310MW | | 400V | FAIRCHILD | 2N3569 | 550035690 |
| R1 | SEL.VAL. | 1/2W | | | AB | TYPE EB | 200200000 |
| R2 | 2K | 1/2W | 5% | | AB | TYPE EB | 200202025 |
| R3 | 820- | 1/4W | 10% | | AB | TYPE CB | 200108216 |
| R4 | 4.7K | 1/4W | 10% | | AB | TYPE CB | 200104726 |
| R5 | 8.2K | 1/4W | 10% | | AB | TYPE CB | 200108226 |
| R6 | 82K | 1/4W | 10% | | AB | TYPE CB | 200108236 |
| R7 | 680- | 1/4W | 10% | | AB | TYPE CB | 200106816 |
| R8 | 4.7K | 1/4W | 10% | | AB | TYPE CB | 200104726 |
| R9 | 27K | 1/4W | 10% | | AB | TYPE CB | 200102736 |
| R10 | 270K | 1/4W | 10% | | AB | TYPE CB | 200102746 |
| R11 | 4.7K | 1/4W | 10% | | AB | TYPE CB | 200104726 |
| R12 | 5K | .25W | | | MALLORY | MTC53L1 | 231205020 |
| R13 | 205- | 1/8W | .5% | | ELECTRA | RN55 SIZE 100 PPM | 220320507 |
| R101 | 200K | 1/2W | 5% | | AB | TYPE EB | 200202045 |
| R102 | 20K | 1/2W | 5% | | AB | TYPE EB | 200202035 |
| R103 | 20K | 1/2W | 5% | | AB | TYPE EB | 200202035 |
| R105 | 2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220220011 |
| R106 | 5K | .25W | | | MALLORY | MTC53L1 | 231205020 |
| R107 | 7680- | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220276811 |
| R108 | 330- | 1/2W | 10% | | AB | TYPE EB | 200203316 |
| R109 | 43.2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220243221 |
| R110 | 43.2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220243221 |
| R201 | 200K | 1/2W | 5% | | AB | TYPE EB | 200202045 |
| R202 | 20K | 1/2W | 5% | | AB | TYPE EB | 200202035 |
| R203 | 20K | 1/2W | 5% | | AB | TYPE EB | 200202035 |
| R205 | 2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220220011 |
| R206 | 5K | .25W | | | MALLORY | MTC53L1 | 231205020 |
| R206 | 5K | .25W | | | MALLORY | MTC53L1 | 231205020 |
| R207 | 7680- | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220276811 |
| R208 | 330- | 1/2W | 10% | | AB | TYPE EB | 200203316 |
| R209 | 43.2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220243221 |
| R210 | 43.2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220243221 |
| R301 | 200K | 1/2W | 5% | | AB | TYPE EB | 200202045 |
| R302 | 20K | 1/2W | 5% | | AB | TYPE EB | 200202035 |
| R303 | 20K | 1/2W | 5% | | AB | TYPE EB | 200202035 |
| R305 | 2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220220011 |
| R306 | 5K | .25W | | | MALLORY | MTC53L1 | 231205020 |
| R307 | 7680- | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220276811 |
| R308 | 330- | 1/2W | 10% | | AB | TYPE EB | 200203316 |
| R309 | 43.2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220243221 |
| R310 | 43.2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220243221 |
| R401 | 200K | 1/2W | 5% | | AB | TYPE EB | 200202045 |
| R402 | 20K | 1/2W | 5% | | AB | TYPE EB | 200202035 |
| R403 | 20K | 1/2W | 5% | | AB | TYPE EB | 200202035 |
| R405 | 2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220220011 |
| R406 | 5K | .25W | | | MALLORY | MTC53L1 | 231205020 |
| R407 | 7680- | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220276811 |
| R408 | 330- | 1/2W | 10% | | AB | TYPE EB | 200203316 |
| R409 | 43.2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220243221 |
| R410 | 43.2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220243221 |

## Table 6–2. (cont'd)

| REFERENCE DESIGNATOR | DESCRIPTION VALUE | POWER | TOL | VOLTS | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|---|---|---|
| R501 | 200K | 1/2W | 5% | | AB | TYPE EB | 200202045 |
| R502 | 20K | 1/2W | 5% | | AB | TYPE EB | 200202035 |
| R503 | 20K | 1/2W | 5% | | AB | TYPE EB | 200202035 |
| R505 | 2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220220011 |
| R506 | 5K | .25W | | | MALLORY | MTC53L1 | 231205020 |
| R507 | 7680- | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220276811 |
| R508 | 330- | 1/2W | 10% | | AB | TYPE EB | 200203316 |
| R509 | 43.2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220243221 |
| R510 | 43.2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220243221 |
| R601 | 200K | 1/2W | 5% | | AB | TYPE EB | 200202045 |
| R602 | 20K | 1/2W | 5% | | AB | TYPE EB | 200202035 |
| R603 | 20K | 1/2W | 5% | | AB | TYPE EB | 200202035 |
| R605 | 2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220220011 |
| R606 | 5K | .25W | | | MALLORY | MTC53L1 | 231205020 |
| R607 | 7680- | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220276811 |
| R608 | 330- | 1/2W | 10% | | AB | TYPE EB | 200203316 |
| R609 | 43.2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220243221 |
| R610 | 43.2K | 1/8W | 1% | | ELECTRA | RN55 SIZE 100 PPM | 220243221 |
| T1 | P6000T S600SPL AUDIO PC | | | | UTC | S0-15P | 400300200 |
| XQ101 | SKT | | | | ELCO | 05-3303 | 826600100 |
| XQ201 | SKT | | | | ELCO | 05-3303 | 826600100 |
| XQ301 | SKT | | | | ELCO | 05-3303 | 826600100 |
| XQ401 | SKT | | | | ELCO | 05-3303 | 826600100 |
| XQ501 | SKT | | | | ELCO | 05-3303 | 826600100 |
| XQ601 | SKT | | | | ELCO | 05-3303 | 826600100 |

## Table 6–3. CB1 Parts List.

| REFERENCE DESIGNATOR | DESCRIPTION VALUE | POWER | TOL | VOLTS | MFGR. | MFGR. PART NO. | N.E.C. PART NO. |
|---|---|---|---|---|---|---|---|
| C1 | 20MF | | | 50V | SPRAGUE | TE1305 | 300202061 |
| C2 | 1UF | | 20% | 200V | ACUSHNET | PRC927N-13 | 320701050 |
| CR1 | D041 | 3 | | 400V | HORIZON | IN4004 | 560040040 |
| CR2 | A-1 | 400mA | 5% | 12V | TRANSITRON | 1N759A | 562007591 |
| CR3 | A-1 | 400mA | 5% | 12V | TRANSITRON | 1N759A | 562007591 |
| R1 | 1.2K | 3W | 5% | | W LEONARD | TYPE 3X | 210301225 |
| R2 | 5000 | 3W | 5% | | W LEONARD | TYPE 3X | 210305015 |
| R5 | 10K | 1/2W | 10% | | AB | TYPE EB | 200201036 |
| R6 | 1K | 3W | 5% | | W LEONARD | TYPE 3X | 210301025 |

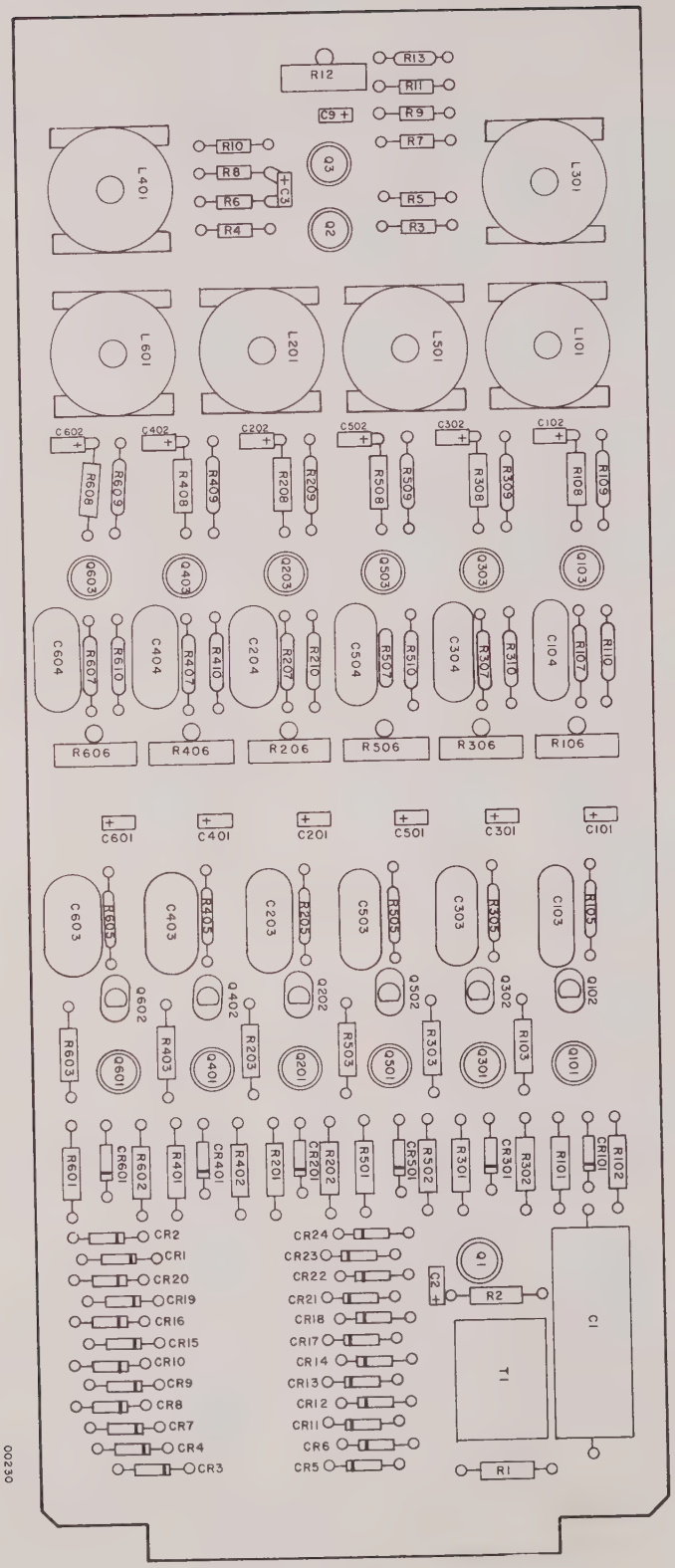



Figure 6—1. Oscillator Circuit Board E95648 Component Location Diagram.

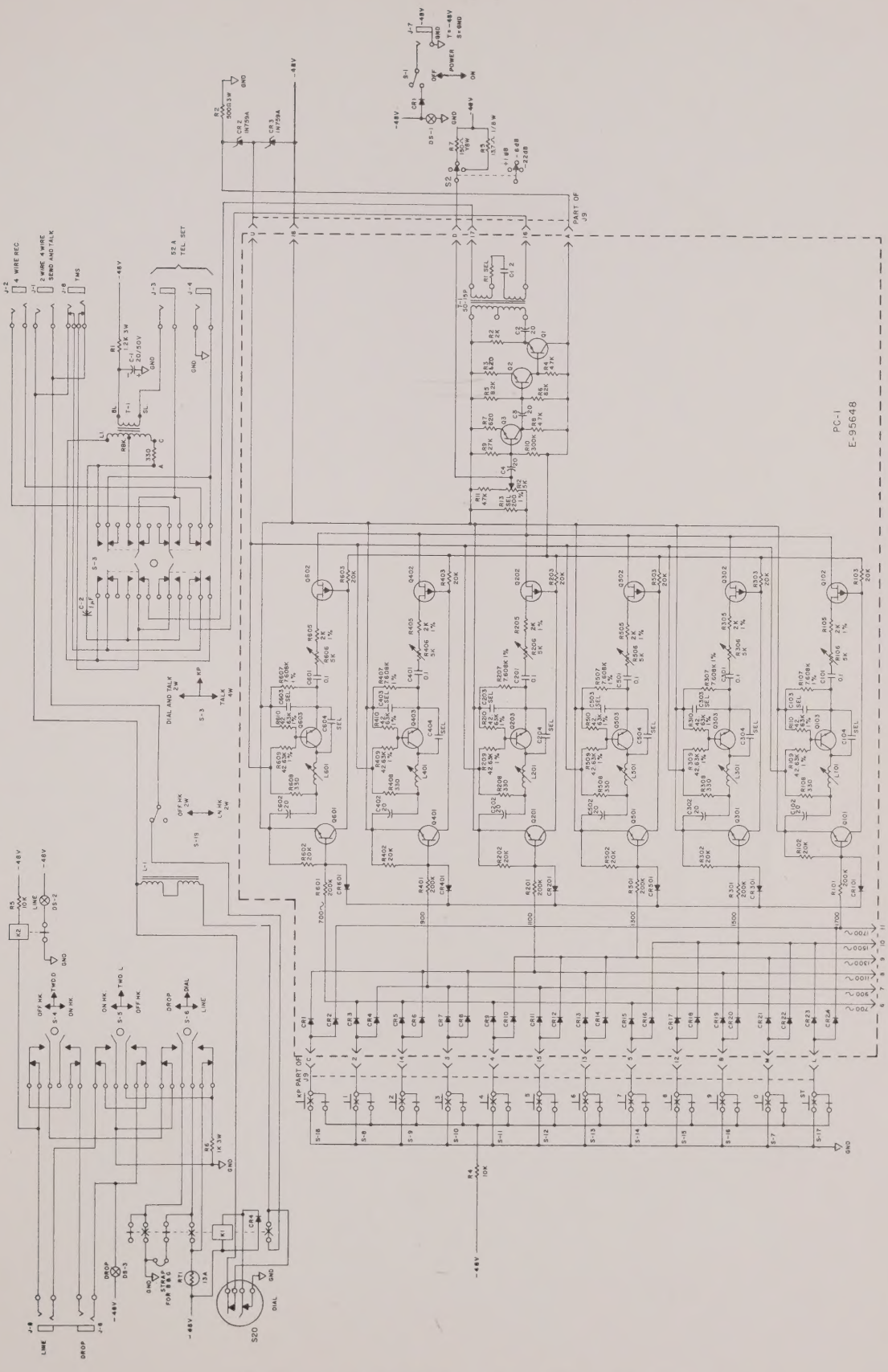
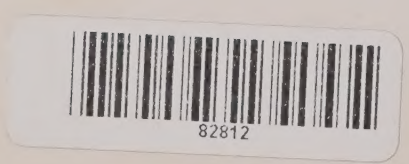


Figure 5—1. TTS 59A Overall Schematic Diagram.


82812